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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: BARROUX

Serial No.: 10/809,833

Filed: March 26, 2004

For: Lumping And Delumping Method For Describing Hydrocarbon-Containing Fluids

Art Unit: 2123

Examiner: Craig, D.

AMENDMENT AFTER FINAL REJECTION

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July 19, 2007

Sir:

This is in response to the Office Action mailed April 19, 2007, in connection with the above-identified application. The amendments are listed below and set forth on the following pages.

Amendments to the Claims; and

Remarks are included following the amendments.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method for projecting dimensioning and management of surface installations of a hydrocarbon reservoir under production, by means of a lumping method for estimating the properties or the behavior of fluids comprising liquid and/or vapor hydrocarbon phases from data relative to a reference set consisting of hydrocarbon mixtures in a series of thermodynamic states resulting from determined conditions of production of ~~an underground hydrocarbon reservoirs~~ the hydrocarbon reservoir, characterized in that it comprises:

- grouping each one of said hydrocarbon mixtures into at least three constituents (V, I, H), none of these constituents corresponding to a particular selection of base components or pseudo-components that would be used for a detailed compositional description of the fluids, considering that the gas phases resulting from separation under surface conditions of each one of the hydrocarbon mixtures are mixtures from which third constituent (H) is excluded, and that the oil phases resulting from the separation under surface conditions of each one of the hydrocarbon mixtures are mixtures from which first constituent (V) is excluded,

- determining by material balance the compositions of the separation products comprising, for the gaseous products, at least the first and the second constituent (V, I) in variable proportions and, for the liquid products, at least the second and the third constituent (I, H) in variable proportions, ~~and~~

- determining the at least three-constituent composition of each hydrocarbon mixture of the reference set by combination of the products of the separation thereof in proportion to the amounts of each separation product,

-simulating a production of the hydrocarbon reservoir while establishing detailed compositional profiles from the at least three-constituent composition, and

- projecting dimensioning and management of the surface installations from the simulated production of the hydrocarbon reservoir.

2. (Previously Presented) A method as claimed in claim 1, wherein each one of the hydrocarbon mixtures is grouped into only three constituents (V, I, H), the gas phases resulting from said separation being mixtures in variable proportions of first constituent (V) and of second constituent (I), the oil phases resulting from said separation are mixtures in variable proportions of second constituent (I) and of third constituent (H), and the three-constituent composition is determined.

3. (Previously Presented) A method as claimed in claim 1 , wherein the surface conditions are the conditions encountered or expected during reservoir production.

4. (Previously Presented) A method as claimed in claim 1, wherein the surface conditions are different from the conditions encountered or expected during reservoir production.

5. (Previously Presented) A method as claimed in claim 1, wherein the material balance is a mass balance and a molar mass is assigned to each one of the

three constituents (V, I, H) after quantitative analysis of the molar masses of the separation products of the reference set.

6. (Previously Presented) A method as claimed in claim 1, wherein the data necessary for equilibrium calculation and for modeling the phase properties in the lumped representation are defined using the compositions of the phases in the lumped representation and known or estimated a priori data relative to at least the density and the viscosity of the oil and gas phases at equilibrium belonging to the reference set.

7. (Previously Presented) A method as claimed in claim 6 wherein, when said data includes detailed compositional data of the phases previously represented by a state equation, the parameters of a first state equation of the lumped representation, used for modeling the phase properties, are defined using this compositional data.

8. (Previously Presented) A method as claimed in claim 7, wherein the parameters of a second state equation of the lumped representation, useful for equilibrium calculations, are adjusted in order to reproduce the equilibrium coefficients of the lumped representation.

9. (Previously Presented) A method as claimed in claim 8, wherein the parameters per constituent of the lumped representation in the first state equation are used in the adjustment procedure for defining the parameters of the second state equation of the lumped representation useful for equilibrium calculations.

10. (Previously Presented) A method as claimed in claim 1, wherein the equilibrium coefficients of the fluids are determined in a detailed compositional representation, from variables and/or parameters involved in the calculation of the phase properties, from the moment that the parameters useful for calculation of the phase properties in the lumped representation have been estimated so as to reproduce the parameters of the phases in the state equation of the detailed compositional description.

11. (Previously Presented) A method as claimed in claim 1, comprising delumping for predicting as a function of time, and in at least one thermodynamic zone, a detailed composition of a fluid contained in a hydrocarbon reservoir or produced by at least one well.

12. (Previously Presented) A method as claimed in claim 11, comprising :

- representing the reservoir in the form of a network of grid cells (m) wherein each one forms an elementary volume filled with fluids in form of one or more phases, with at least one non-aqueous phase,

- defining, for each thermodynamic zone or range, the fluids by a detailed base representation, so as to determine the amount of each base constituent (i) in each hydrocarbon phase in each grid cell (m) at the time defined as initial for the delumping calculation,

- per thermodynamic zone for which a lumped representation of the fluids is selected, determining a state equation constructed prior to dynamic reservoir simulation with the lumped representation, to reproduce the phase parameters, in the state equation of the detailed representation, of the hydrocarbon fluids along

thermodynamic paths considered to be representative of those that will be followed by the hydrocarbon fluids during the gridded simulation,

- carrying out, at a time interval t, a compositional simulation with a limited number of constituents wherein the phase properties are calculated by a state equation, said simulation allowing to calculate at least in each grid cell (m) and at consecutive time intervals a pressure for a hydrocarbon phase, the temperature when it varies, the flow rates of the phases between grid cells and at the production and injection perforations, and the values of parameters and/or phase properties involved in the formal expression of the equilibrium coefficients of the detailed representation, and storing these various quantities,

- estimating at the next time interval (t+1) the molar fraction of each constituent i in the global detailed composition of the hydrocarbon fluid in grid cell (m) by material balance on grid cell (m),

- determining, using the quantities stored, at the same time interval (t+1) and in each grid cell (m), the equilibrium coefficients of each constituent (i) in the detailed representation,

- determining, in the same time interval (t+1), the vaporized fraction in each grid cell (m), and

- estimating the detailed composition of each hydrocarbon phase, at the same time interval (t+1) and in each grid cell (m).

13. (Previously Presented) A method as claimed in claim 1, wherein various stages are translated so as to produce intermediate or final results usable in equations expressed according to a molar or mass formalism.

REMARKS

By this amendment, Applicant has amended claim 1 to more clearly define her invention. In particular, the preamble of claim 1 has been amended to recite that the method is a method for projecting dimensioning and management of surface installations of a hydrocarbon reservoir under production, by means of the recited lumping method. Claim 1 has also been amended to add the steps of "simulating a production of the hydrocarbon reservoir while establishing detailed compositional profiles from the at least three-constituent composition" and "projecting dimensioning and management of the surface installations from the simulated production of the hydrocarbon reservoir." These amendments are supported by Applicant's specification, e.g., page 1, lines 17-22.

The Examiner is thanked for the telephone interview conducted between the Examiner and the undersigned on even date. During the interview, the legal basis for the rejection under 35 U.S.C. 101 was discussed. In addition, the undersigned proposed amending claim 1 or adding a new independent claim directed to a method for projecting dimensioning and management of surface installations of a hydrocarbon reservoir under production. The Examiner indicated that the addition of a new claim would likely cause the amendment to be refused entry, while amendments to the independent claim, in response to the rejection under 35 U.S.C. 101, would have a better chance for entry after final rejection. Accordingly, the foregoing amendments to claim 1 were discussed with reference to page 1, lines 17-22 of Applicant's specification. The Examiner indicated he would consider Applicant's amendment but could provide no indication as to entry of the amendment or allowance of the application

Entry of this amendment under 37 CFR 1.116 is requested. Initially, it is submitted the foregoing amendments place the application in condition for allowance

for the reasons set forth hereinafter, or at least, in better form consideration on appeal. Moreover, the amendments are necessary in order to respond to the more detailed arguments made by the Examiner in support of the rejection under 35 U.S.C. 101 in the outstanding final Office Action. Since the foregoing amendments do not delete any limitations from claim 1 (previously indicated as being allowable over the prior art) it is submitted the foregoing amendments do not require any further consideration with respect to the prior art and/or search. Therefore, entry of this amendment under 37 CFR. 1.116 is proper.

Claims 1-13 stand rejected under 35 U.S.C. 101 as allegedly being directed to non-statutory subject matter. Applicant traverses this rejection and request reconsideration thereof.

The present invention relates to a lumping method for estimating the properties or the behavior of fluids comprising liquid and/or vapor hydrocarbon phases from data relative to a reference set consisting of hydrocarbon mixtures in a series of thermodynamic states resulting from determined conditions of production of an underground hydrocarbon reservoirs. The method is useful for projecting dimensioning and management of surface installations of a hydrocarbon reservoir under production, as now more specifically set forth in the amended claims.

Such a method is a "process" that falls within one of the four enumerated categories of patentable subject matter under 35 U.S.C. 101. The Supreme Court has construed section 101 broadly, noting that Congress intended statutory subject matter to "include anything under the sun that is made by man." *Diamond v. Charkrabraty,* 447 US 303, 309 (1980). Despite this seemingly limitless expanse, the Court has specifically identified three categories of unpatentable subject matter: laws of nature, natural phenomena and abstract ideas. *Diamond v. Diehr,* 450 US

175, 185 (1981); *AT&T Corp. v. Excel Communication, Inc.*, 172 F.3d, 1352, 50 USPQ 2d 1447, 1450 (Fed. Cir. 1999), *cert. denied*, 528 U.S. 946 (1999).

In the final rejection in this case, the Examiner disagrees with applicant's previous arguments that the claimed method produces a useful, concrete, and tangible result, and alleges the claims do not "teach a tangible result," "disclose mathematical steps" and "describe abstract ideas." However, while certain types of mathematical subject matter, standing alone, represent nothing more than abstract ideas until reduced to some type of practical application, i.e., a useful, concrete, and tangible result, a mathematical algorithm is unpatentable *only* to the extent that it represents an abstract idea. *State Street Bank & Trust v. Signature Financial Group*, 149 F.3d 1368, 47 USPQ 2d 1596, 1600-1601 (Fed. Cir. 1998), *cert. denied*, 525 U.S. 1093 (1999). Thus, unpatentable mathematical algorithms are identifiable by showing they are merely abstract ideas constituting disembodied concepts or truths that are not "useful." From a practical standpoint, this means that, to be patentable, an algorithm must be applied in a "useful" way. *State Street, supra,* 47 USPQ 2d at 1601. Here, the claimed method produces a useful, concrete and tangible result and therefore constitutes patentable subject matter.

In the final rejection, the Examiner appears to require that the claims identify a "physical structure of manufacture in terms of its hardware, or a hardware software combination" for the method to satisfy the "useful, concrete and tangible result" requirement. The Examiner's reliance on physical structure is misplaced since the tangible result requirement does not necessarily mean that a claim must either be tied to a particular machine or apparatus or must operate to change articles or materials to the different state or thing. *AT&T Corp., supra*, 50 USPQ 2d at 1452-53. See, also, *Manual of Patent Examining Procedure* (*MPEP*) §2106.

The Court of Appeals for the Federal Circuit has examined the "useful, concrete and tangible result" requirement in a number of cases. In *In re Alappat,* 33 F.3d 1526, 31 USPQ 2d 1545 (Fed. Cir. 1994) (*in banc)*, the court held that data, transformed by a machine through a series of mathematical calculations to produce a smooth waveform display on a rasterizer monitor, constituted a practical application of an abstract idea (a mathematical algorithm, formula or calculation), because it produced "a useful, concrete and tangible result," i.e., the smooth waveform.

In *Arrythmia Research Technology Inc. v. Corazonix Corp.* 958 F.2d 1053, 22 USPQ 2d 1033 (Fed. Cir. 1992), the court held that the transformation of electrocardiograph signals from a patient's heartbeat by a machine through a series of mathematical calculations constituted a practical application of an abstract idea, (a mathematical algorithm, formula or calculation), because it corresponded to a useful, concrete or tangible thing, i.e., the condition of a patient's heart. In *Arrythmia*, the court noted the fact that the product is numerical is not a criterion on whether the claim is directed to statutory subject matter. *Arrythmia, supra*, 958 2d at 1060, 22 USPQ 2d at 1039.

In *State Street, supra*, the court held that the transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constituted a practical application of a mathematical algorithm, formula, or calculation, because it produces "a useful, concrete and tangible result," i.e., a final share price momentarily fixed for recording and reporting purposes.

In *AT&T, supra*, the court held that the derivation of a primary interexchange carrier (PIC) indicator using a simple mathematical principle was patentable subject matter since the claimed method produced a useful, concrete and tangible result

without pre-empting other uses of the mathematical principle. The court found it irrelevant that the claims lacked a physical transformation or a physical limitation.

In the present case, the claimed method obtains the at least three-constituent composition of each hydrocarbon mixture of the reference set by combination of the products of the separation thereof in proportion to the amounts of each separation product. The claimed method is useful for projecting dimensioning and management of surface installations of a hydrocarbon reservoir under production, as now more specifically set forth in the amended claims. It is clear that this result is or corresponds to a useful, concrete or tangible thing.

For the foregoing reasons, it is submitted the claimed invention as a whole, especially as presently amended, is drawn to statutory subject matter.

In view of the foregoing amendments and remarks, entry of this amendment and favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.43683X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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